RF Exposure Report

Report No.:	SA161201C02
FCC ID:	G95-MGM0110VZN
Equipment Name:	LTE Router
Trade Name:	technicolor
Model Number:	MBHA10
Product Code:	DSLMVZ011GM
Received Date:	Dec. 01, 2016
Test Date:	Jan. 10 to 18, 2017
Issued Date:	Jan. 23, 2017
Applicant:	Technicolor Connected Home USA LLC
Address:	5030 Sugarloaf Parkway Building Lawrenceville Georgia United States 30044
Issued By:	Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch Hsin Chu Laboratory
Lab Address:	E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300, Taiwan R.O.C.

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Release Control Record

Issue No.	Description	Date Issued
SA161201C02	Original release.	Jan. 23, 2017

1 Certificate of Conformity

Product:	LTE Router
Brand:	technicolor
Test Model:	MBHA10
Product Code:	DSLMVZ011GM
Sample Status:	Product Unit
Applicant:	Technicolor Connected Home USA LLC
Test Date:	Jan. 10 to 18, 2017
Standards:	FCC Part 2 (Section 2.1091) KDB 447498 D01 General RF Exposure Guidance v06 IEEE C95.1-1992

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by : _____ , **Date:** Jan. 23, 2017

Claire Kuan / Specialist

Approved by : _____ , **Date:** Jan. 23, 2017

May Chen / Manager

2 RF Exposure

2.1 Limits For Maximum Permissible Exposure (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Average Time (minutes)
Limits For General Population / Uncontrolled Exposure				
300-1500	…	…	F/1500	30
1500-100,000	…	…	1.0	30

F = Frequency in MHz

2.2 MPE Calculation Formula

$Pd = (Pout*G) / (4*pi*r^2)$

where

Pd = power density in mW/cm^2

Pout = output power to antenna in mW

G = gain of antenna in linear scale

Pi = 3.1416

R = distance between observation point and center of the radiator in cm

2.3 Classification

The antenna of this product, under normal use condition, is at least 20cm away from the body of the user. So, this device is classified as **Mobile Device**.

2.4 Antenna Gain

For WLAN – 2.4GHz:

Antenna Information					
Ant.	**Brand**	**Model No.**	**Antenna Type**	**Connector**	**Cable Length**
A1	**INPAQ**	**WA-F-LA-02-020**	**PCB Antenna**	**I-PEX**	**44.5 mm**
A2	**INPAQ**	**WA-P-DAG1-03-001**	**PCB Antenna**	**I-PEX**	**105 mm**

Number of Transmitter Antennas & Bandwidth

Number of Transmitter Antennas	**1TX**		**2TX**	
Bandwidth Mode	**20 MHz**	**40 MHz**	**20 MHz**	**40 MHz**
802.11b	**V**	**X**	**X**	**X**
802.11g	**V**	**X**	**V**	**X**
802.11n	**V**	**V**	**V**	**V**

For 2400~2483.5MHz

Frequency	**Antenna Gain (dBi)**			
	Ant. A1 (J711)		**Ant. A2 (J710)**	
	20 MHz	**40 MHz**	**20 MHz**	**40 MHz**
2412MHz	**2.90**	**-**	**2.78**	**-**
2422MHz	**-**	**2.66**	**-**	**2.60**
2437MHz	**2.89**	**2.89**	**2.68**	**2.68**
2452MHz	**-**	**2.87**	**-**	**2.58**
2462MHz	**2.87**	**-**	**2.71**	**-**

Frequency	**Maximum Gain (dBi) for SDM mode**	
	SDM mode (2 Stream 2 TX) for Power & PSD Gain (KDB 662911 Option 2)	
	20 MHz	**40 MHz**
2412MHz	**1.93**	**-**
2422MHz	**-**	**1.75**
2437MHz	**1.76**	**1.76**
2452MHz	**-**	**1.66**
2462MHz	**1.78**	**-**

Note:

1. Antenna Gain refer to “General MBHA10 antenna table_20161205.xls” files
2. Maximum Correlated Directional Gain = 10 log[(10 G1 / 20 + 10 G2 / 20 + … +10 GN / 20)2 / N ANT] dBi
Maximum Uncorrelated Directional Gain = 10 log[(10 G1 / 10 + 10 G2 / 10 + … +10 GN / 10) / N ANT] dBi

For WLAN – 5GHz:

Antenna Information					
Ant.	**Brand**	**Model No.**	**Antenna Type**	**Connector**	**Cable Length**
B1	**INPAQ**	**WA-F-LB-04-005**	**FPCB Antenna**	**I-PEX**	**35 mm**
B2	**INPAQ**	**WA-P-LC-01-037**	**PCB Antenna**	**I-PEX**	**83 mm**

Number of Transmitter Antennas & Bandwidth

Number of Transmitter Antennas	**1TX**			**2TX**		
Bandwidth Mode	**20 MHz**	**40 MHz**	**80 MHz**	**20 MHz**	**40 MHz**	**80 MHz**
802.11a	**V**	**X**	**X**	**V**	**X**	**X**
802.11n	**V**	**V**	**X**	**V**	**V**	**X**
802.11ac	**V**	**V**	**X**	**V**	**V**	**X**

Frequency	**Antenna Gain (dBi)**			
	Ant. B1 (WAJ1)		**Ant. B2 (WAJ2)**	
	20 MHz	**40 MHz**	**20 MHz**	**40 MHz**
5180MHz	4.86		4.93	
5190MHz		4.69		4.83
5200MHz	4.69		4.85	
5230MHz		3.86		4.87
5240MHz	4.06		4.46	
5260MHz	4.33		4.95	
5270MHz		4.58		4.88
5300MHz	4.93		4.67	
5310MHz		4.81		4.52
5320MHz	4.34		4.30	
5500MHz	3.83		3.15	
5510MHz		3.90		3.31
5550MHz		4.07		3.68
5580MHz	3.81		3.75	
5610MHz	3.65		3.93	
5620MHz		3.92		4.02
5670MHz		4.36		4.17
5700MHz	4.49		4.31	
5710MHz		4.53		4.34
5720MHz	4.57		4.26	
5745MHz	4.58		4.06	
5755MHz		4.55		3.96
5785MHz	4.61		3.65	
5795MHz		4.65		3.70
5825MHz	4.83		4.64	

Note:

1. Antenna Gain refer to “General MBHA10 antenna table_20161205.xls” files

Frequency	Maximum Gain (dBi) for CDD mode			
	CDD mode (1 Stream 2 TX) for Power Gain (KDB 662911 Option 1)		CDD mode (1 Stream 2 TX) for PSD Gain (KDB 662911 Option 2)	
	20 MHz	40 MHz	20 MHz	40 MHz
5180MHz	4.93		6.58	
5190MHz		4.83		6.75
5200MHz	4.85		6.84	
5230MHz		4.87		6.74
5240MHz	4.46		6.51	
5260MHz	4.95		6.90	
5270MHz		4.88		7.03
5300MHz	4.93		7.17	
5310MHz		4.81		7.17
5320MHz	4.34		7.05	
5500MHz	3.83		6.05	
5510MHz		3.9		6.04
5550MHz		4.07		5.94
5580MHz	3.81		5.72	
5610MHz	3.93		5.46	
5620MHz		4.02		5.47
5670MHz		4.36		5.07
5700MHz	4.49		5.19	
5710MHz		4.53		5.26
5720MHz	4.57		5.32	
5745MHz	4.58		5.15	
5755MHz		4.55		4.99
5785MHz	4.61		4.96	
5795MHz		4.65		4.93
5825MHz	4.83		4.87	

Note:

1. Antenna Gain refer to “General MBHA10 antenna table_20161205.xls” files
2. Maximum Correlated Directional Gain = $10 \log[(10^{G1/20} + 10^{G2/20} + \ldots + 10^{GN/20})^2 / N_{ANT}]$ dBi
3. Maximum Uncorrelated Directional Gain = $10 \log[(10^{G1/10} + 10^{G2/10} + \ldots + 10^{GN/10}) / N_{ANT}]$ dBi

Frequency	Maximum Gain (dBi) for SDM & TxBF mode			
	SDM mode (2 Stream 2 TX) for Power & PSD Gain (KDB 662911 Option 2)		TXBF mode (1 Stream 2 TX) for Power & PSD Gain (KDB 662911 Option 2)	
	20 MHz	40 MHz	20 MHz	40 MHz
5180MHz	3.65		6.58	
5190MHz		3.82		6.75
5200MHz	3.90		6.84	
5230MHz		3.81		6.74
5240MHz	3.56		6.51	
5260MHz	3.96		6.90	
5270MHz		4.06		7.03
5300MHz	4.17		7.17	
5310MHz		4.16		7.17
5320MHz	4.05		7.05	
5500MHz	3.04		6.05	
5510MHz		3.03		6.04
5550MHz		2.94		5.94
5580MHz	2.73		5.72	
5610MHz	2.46		5.46	
5620MHz		2.47		5.47
5670MHz		2.40		5.07
5700MHz	2.57		5.19	
5710MHz		2.62		5.26
5720MHz	2.66		5.32	
5745MHz	2.44		5.15	
5755MHz		2.26		4.99
5785MHz	2.12		4.96	
5795MHz		2.10		4.93
5825MHz	2.08		4.87	

Note:

1. Antenna Gain refer to “General MBHA10 antenna table_20161205.xls” files
2. Maximum Correlated Directional Gain = $10 \log[(10^{G1/20} + 10^{G2/20} + \ldots + 10^{GN/20})^2 / N_{ANT}]$ dBi
3. Maximum Uncorrelated Directional Gain = $10 \log[(10^{G1/10} + 10^{G2/10} + \ldots + 10^{GN/10}) / N_{ANT}]$ dBi

For LTE:

Antenna Information					
Ant.	**Brand**	**Model No.**	**Antenna Type**	**Connector**	**Cable Length**
LTE1	INPAQ	WA-F-LTE5LA-04-001	FPCB Antenna	I-PEX	79.2 mm
LTE2	INPAQ	WA-F-LTE5LALC-12-001	FPCB Antenna	I-PEX	61.3 mm

Ant	**UTRA Band**	**Uplink (UL)**						**Downlink (DL)**					
		Freq.	**Gain**	**Freq.**	**Gain**	**Freq.**	**Gain**	**Freq.**	**Gain**	**Freq.**	**Gain**	**Freq.**	**Gain**
LTE 1	Band IV	1710	1.83	1747.5	1.99	1785	1.91	2110	0.89	2132.5	1.79	2155	1.86
	Band XIII	777	2.67	782	2.35	787	1.96	746	1.06	750.5	1.58	756	1.94
LTE 2	Band IV	1710	1.73	1747.5	1.53	1785	1.36	2110	1.78	2132.5	1.93	2155	2.27
	Band XIII	777	0.81	782	0.78	787	0.85	746	1.01	750.5	0.72	756	0.44

Note: Freq. (Frequency) unit is “MHz”.

For Zigbee:

Antenna Information					
Ant.	**Brand**	**Model No.**	**Antenna Type**	**Connector**	**Cable Length**
Zigbee	**Foxconn**	**-**	**Printing Antenna**	**-**	**-**

For 2400~2483.5MHz

Frequency	**Antenna Gain (dBi)**
	Ant. 1 (Cn12)
2405MHz	**2.81**
2440MHz	**2.85**
2475MHz	**2.76**
2480MHz	**2.43**

For Z-wave:

Antenna Information					
Ant.	Brand	Model No.	Antenna Type	Connector	Cable Length
Z-wave	INPAQ	WA-P-DAG1-03-001	PCB Antenna	I-PEX	115 mm

Frequency	Antenna Gain (dBi)
	Ant. 1 (Cn10)
908.4MHz	0.34

For BT-LE:

Antenna Information					
Ant.	Brand	Model No.	Antenna Type	Connector	Cable Length
BT-LE	INPAQ	WA-F-LB-04-005	FPCB Antenna	I-PEX	204 mm

For 2400~2483.5MHz

Frequency	Antenna Gain (dBi)
	Ant. 1 (J709)
2402MHz	2.89
2440MHz	2.74
2480MHz	2.85

2.5 Calculation Result of Maximum Conducted Power

For WLAN – 2.4GHz:

Frequency Band (MHz)	Max Conducted Power (mW)	Directional Gain (dBi)	Distance (cm)	Power Density (mW/cm^2)	Limit (mW/cm^2)
2412-2462	120.504	2.94	20	0.04718	1

Note:

1. Pout*G = EIRP Power = Max Conducted Power(mW) * Gain(numeric)
2. Gain(dBi) to Gain(numeric) = $10^{(2.94/10)}$ = 1.9679
3. Distance (cm) = r = declare by manufacture = 20 cm
4. Pd = (Pout*G) / ($4*pi*r^2$) = (120.504 * 1.9679) / (4 * 3.1416 * 20^2) = 0.04718 (mW/cm2)

For WLAN – 5GHz_U_NII 1:

Frequency Band (MHz)	Max Conducted Power (mW)	Directional Gain (dBi)	Distance (cm)	Power Density (mW/cm^2)	Limit (mW/cm^2)
5150~5250	235.505	6.84	20	0.22632	1

Note:

1. Pout*G = EIRP Power = Max Conducted Power(mW) * Gain(numeric)
2. Gain(dBi) to Gain(numeric) = $10^{(6.84/10)}$ = 4.8306
3. Distance (cm) = r = declare by manufacture = 20 cm
4. Pd = (Pout*G) / ($4*pi*r^2$) = (235.505 * 4.8306) / (4 * 3.1416 * 20^2) = 0.22632 (mW/cm2)

For WLAN – 5GHz_U_NII 3:

Frequency Band (MHz)	Max Conducted Power (mW)	Directional Gain (dBi)	Distance (cm)	Power Density (mW/cm^2)	Limit (mW/cm^2)
5725~ 5850	185.353	5.15	20	0.12071	1

Note:

1. Pout*G = EIRP Power = Max Conducted Power(mW) * Gain(numeric)
2. Gain(dBi) to Gain(numeric) = $10^{(5.15/10)}$ = 3.2734
3. Distance (cm) = r = declare by manufacture = 20 cm
4. Pd = (Pout*G) / ($4*pi*r^2$) = (185.353 * 3.2734) / (4 * 3.1416 * 20^2) = 0.12071 (mW/cm2)

For Zigbee:

Frequency (MHz)	Max Conducted Power (mW)	Directional Gain (dBi)	Distance (cm)	Power Density (mW/cm^2)	Limit (mW/cm^2)
2405-2475	58.076	2.85	20	0.02227	1

Note:

1. Pout*G = EIRP Power = Max Conducted Power(mW) * Gain(numeric)
2. Gain(dBi) to Gain(numeric) = $10^{(2.85/10)}$ = 1.9275
3. Distance (cm) = r = declare by manufacture = 20 cm
4. Pd = (Pout*G) / ($4*pi*r^2$) = (58.076 * 1.9275) / (4 * 3.1416 * 20^2) = 0.02227 (mW/cm2)

For BT-LE:

Frequency (MHz)	Max Conducted Power (mW)	Directional Gain (dBi)	Distance (cm)	Power Density (mW/cm^2)	Limit (mW/cm^2)
2402-2480	6.871	2.74	20	0.00257	1

Note:

1. Pout*G = EIRP Power = Max Conducted Power(mW) * Gain(numeric)
2. Gain(dBi) to Gain(numeric) = $10^{(2.74/10)}$ = 1.8793
3. Distance (cm) = r = declare by manufacture = 20 cm
4. Pd = (Pout*G) / ($4*pi*r^2$) = (6.871 * 1.8793) / (4 * 3.1416 * 20^2) = 0.00257 (mW/cm2)

For Z-Wave:

Frequency (MHz)	Field Strength of Fundamental (dBuv/m)	Pout EIRP (dBm)	Pout EIRP (mW)	Distance (cm)	Power Density (mW/cm^2)	Limit (mW/cm^2)
902-928	93.9	-1.33	0.736	20	0.00015	0.606

Note:

1. Limit of Power Density =F/1500 = 908.4(MHz)/1500 = 0.606(mW/cm^2)
2. Pout*G = EIRP Power = Field Strength of Fundamental(dBuv/m) - 95.23 = -1.33(dBm)
3. Pout EIRP(dBm) to Pout EIRP(mW) = $10^{(-1.33/10)}$ = 0.736 (mW)
4. Distance (cm) = r = declare by manufacture = 20 cm
5. Pd = (Pout*G) / ($4*pi*r^2$) = (0.736) / (4 * 3.1416 * 20^2) = 0.00015 (mW/cm2)

For LTE Band 4:

Frequency (MHz)	Pout EIRP (dBm)	Pout EIRP (mW)	Distance (cm)	Power Density (mW/cm^2)	Limit (mW/cm^2)
1712.5-1752.5	26.51	447.713	20	0.08907	1

Note:

1. Pout*G = EIRP Power = 26.51(dBm)
2. Pout EIRP(dBm) to Pout EIRP(mW) = $10^{(26.51/10)}$ = 447.713 (mW)
3. Distance (cm) = r = declare by manufacture = 20 cm
4. Pd = (Pout*G) / ($4*pi*r^2$) = (447.713) / (4 * 3.1416 * 20^2) = 0.08907 (mW/cm2)

For LTE Band 13:

Frequency (MHz)	Pout EIRP (dBm)	Pout EIRP (mW)	Distance (cm)	Power Density (mW/cm^2)	Limit (mW/cm^2)
779.5-784.5	26.27	423.643	20	0.08428	0.521

Note:

1. Limit of Power Density =F/1500 = 782(MHz)/1500 = 0.521(mW/cm^2)
2. Pout*G = EIRP Power = 26.27(dBm)
3. Pout EIRP(dBm) to Pout EIRP(mW) = $10^{(26.27/10)}$ = 423.643 (mW)
4. Distance (cm) = r = declare by manufacture = 20 cm
5. Pd = (Pout*G) / ($4*pi*r^2$) = (423.643 / (4 * 3.1416 * 20^2) = 0.08428 (mW/cm2)

Conclusion:

The formula of calculated the MPE is:

CPD1 / LPD1 + CPD2 / LPD2 + ……etc. < 1

CPD = Calculation power density

LPD = Limit of power density

WLAN 2.4GHz + WLAN 5GHz + Zigbee + Z-Wave + LTE Band 13 + BT-LE = 0.04718 / 1 + 0.22632 / 1 + 0.02227 / 1 + 0.00015 / 0.606 + 0.08428 / 0.521 + 0.00257 / 1 = 0.46025

Therefore the maximum calculations of above situations are less than the "1" limit.

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